CLAIMS

What is claimed is:

1. An horological device comprising:

charging means for receiving and storing an electrostatic charge in a charge storage element in a time cell in the horological device, wherein the charge storage element comprises an internal medium for storing an electrostatic charge and an insulating medium for insulating the internal medium that substantially surrounds the internal medium, and wherein the time cell transitions from a non-time-measuring state to a time-measuring state in the horological device upon receiving the electrostatic charge; and

discharging means for discharging the stored electrostatic charge in the charge storage element using a discharge process with a predetermined discharge rate.

2. The horological device of claim 1 wherein the predetermined discharge rate of the discharge process varies with an initial condition of the time cell after the programming operation.

3. The horological device of claim 1 wherein the predetermined discharge rate of the discharge process is non-linear with respect to time.

4. The horological device of claim 1 wherein the predetermined discharge rate of the discharge process is dependent upon a structure of the charge storage element.

5. The horological device of claim 1 further comprising:
an array of time cells.

6. The horological device of claim 5 wherein at least one time cell in the array of time cells has a predetermined discharge rate that differs from a predetermined discharge rate of another time cell in the array of time cells.

7. The horological device of claim 5 wherein at least two time cells in the array of time cells have substantially identical predetermined discharge rates.

8. The horological device of claim 5 further comprising:
a time cell interface unit for controlling the array of time cells by initializing one or more time cells in the array of time cells.

9. The horological device of claim 5 further comprising:
a programming request processing unit for processing a programming request to set one or more time cells within the array of time cells.

10. A method for using an horological device, the method comprising:

receiving and storing an electrostatic charge in a charge storage element in a time cell in the horological device, thereby transitioning from a non-time-measuring state to a time-measuring state in the horological device, wherein the charge storage element comprises an internal medium for storing an electrostatic charge and an insulating medium for insulating the internal medium that substantially surrounds the internal medium; and

discharging the stored electrostatic charge in the charge storage element using a discharge process with a predetermined discharge rate.

11. The method of claim 10 further comprising:

programming at least one time cell in an array of time cells.

12. The method of claim 11 further comprising:

controlling the array of time cells through a time cell interface unit by initializing one or more time cells in the array of time cells.

13. The method of claim 11 further comprising:

processing a programming request to set one or more time cells within the array of time cells.

14. A computer program product on a computer readable medium for use in a data processing system for using an horological device, the computer program product comprising:

instructions for receiving a programming request to initialize the horological device; and

instructions for programming an electrostatic charge into a charge storage element in a time cell in the horological device, thereby transitioning from a non-time-measuring state to a time-measuring state in the horological device, wherein the charge storage element comprises an internal medium for storing an electrostatic charge and an insulating medium for insulating the internal medium that substantially surrounds the internal medium, wherein the stored electrostatic charge discharges from the charge storage element using a discharge process with a predetermined discharge rate.

15. The computer program product of claim 14 further comprising:

instructions for programming at least one time cell in an array of time cells.

16. The computer program product of claim 15 further comprising:

instructions for controlling the array of time cells through a time cell interface unit by initializing one or more time cells in the array of time cells.

17. The computer program product of claim 15 further comprising:

instructions for processing a programming request to set one or more time cells within the array of time cells.

18. An horological device comprising:

an internal medium for storing an electrostatic charge;

an insulating medium for insulating the internal medium, the internal medium and the insulating medium forming a charge storage element,

wherein the insulating medium substantially surrounds the internal medium;

wherein the insulating medium has physical properties that allow a charging process for charging the internal medium with an electrostatic charge through the insulating medium;

wherein the insulating medium has physical properties that allow a discharge process for discharging a stored electrostatic charge from the internal medium through the insulating medium;

wherein the insulating medium has one or more physical properties that affect a rate of discharge in the discharge process; and

wherein at least one physical property of the insulating medium has been selected so that the discharge process discharges a stored electrostatic charge at a predetermined discharge rate; and

an electrostatic detector physically coupled to the charge storage element for allowing a detection of an electrical potential of the internal medium caused by a retained electrostatic charge in the internal medium.

19. The horological device of claim 18 wherein the predetermined discharge rate is non-linear with respect to time.

20. The horological device of claim 18 wherein the discharge process is Fowler-Nordheim tunneling.

21. The horological device of claim 18 wherein the charging process is channel hot electron injection.

22. The horological device of claim 18 further comprising:

a charge injector for injecting charge through the insulating medium into the internal medium.

23. The horological device of claim 22 further comprising:

a programming unit for programming the charge storage element by operating the charge injector.

24. The horological device of claim 23 further comprising:

a request processing unit for processing requests to program the charge storage element.

25. The horological device of claim 23 further comprising:

a status generating unit for generating status from programming the charge storage element.

26. The horological device of claim 18 wherein the charge storage element is a floating gate in a floating gate field effect transistor.

27. A method for using an horological device, the method comprising:

programming a charge storage element in the horological device by storing an electrostatic charge within the charge storage element, wherein the charge storage element comprises an internal medium for storing an electrostatic charge and an insulating medium for insulating the internal medium,

wherein the insulating medium substantially surrounds the internal medium;

wherein the insulating medium has physical properties that allow a charging process for charging the internal medium with an electrostatic charge through the insulating medium;

wherein the insulating medium has physical properties that allow a discharge process for discharging a stored electrostatic charge from the internal medium through the insulating medium;

wherein the insulating medium has one or more physical properties that affect a rate of discharge in the discharge process; and

wherein at least one physical property of the insulating medium has been selected so that the discharge process discharges a stored electrostatic charge at a predetermined rate; and

discharging the stored electrostatic charge from the charge storage element.

28. The method of claim 27 further comprising:

programming the charge storage element by injecting charge through the insulating medium into the internal medium.

29. The method of claim 27 further comprising:

processing requests to program the charge storage element.

30. The method of claim 27 further comprising:

generating status after attempting to program the charge storage element.

31. The method of claim 27 wherein the charge storage element is a floating gate in a floating gate field effect transistor.

32. An horological device comprising:

a semiconductor substrate;

a first source region;

a first drain region;

a first channel region between the source region and the drain region;

a first control gate;

a second source region;

a second drain region;

a second channel region between the source region and the drain region;

a second control gate;

a floating gate, wherein a first portion of the floating gate is between the first control gate and the

first channel region and a second portion of the floating gate is between the second control gate and the second channel region; and

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an insulating region comprising insulating material substantially surrounding the floating gate, wherein the insulating region comprises a tunneling region for discharging an electrostatic charge stored in the floating gate through a discharge process, wherein the tunneling region has one or more physical properties that affect a rate of discharge in the discharge process, and wherein at least one physical property of the tunneling region has been selected so that the discharge process discharges a stored electrostatic charge at a predetermined rate.

33. The horological device of claim 32 wherein the tunneling region is between the floating gate and the second channel region.

34. The horological device of claim 32 wherein a selected physical property of the tunneling region comprises a selected thickness of the insulating material.

35. The horological device of claim 34 wherein the selected thickness of the tunneling region is less than 7 nanometers.

36. An horological device comprising:

a first floating gate field effect transistor comprising a floating gate;

a second floating gate field effect transistor comprising the floating gate, wherein a portion of the floating gate is common to the first floating gate field effect transistor and the second floating gate field effect transistor; and

an insulating region of insulating material adjacent to the floating gate, wherein a discharge rate of a discharge process that discharges an electrostatic charge stored within the floating gate is inversely related to a thickness of the insulating region, and wherein the thickness of the insulating region is selected to cause a threshold voltage of the second floating gate field effect transistor to reach a predetermined threshold voltage within a predetermined time period after programming the floating gate.

37. The horological device of claim 36 wherein a length of the predetermined time period varies with an initial threshold voltage of the floating gate field effect transistor after programming the floating gate.

38. A method for using an horological device, the method comprising:

programming a first floating gate field effect transistor, wherein the first floating gate field effect transistor comprises a floating gate and an insulating region of insulating material adjacent to the floating gate;

discharging the floating gate through a second floating gate field effect transistor, wherein a portion of the floating gate is common to the first floating gate field effect transistor and the second floating gate field effect transistor, wherein a discharge rate of a discharge process that discharges an electrostatic charge stored within the programmed floating gate is inversely related to a thickness of the insulating region, and wherein the thickness of the insulating region is selected such that a threshold voltage of the second floating gate field effect transistor has a predetermined decay rate after programming the floating gate.

39. The method of claim 38 wherein the predetermined decay rate varies with an initial threshold voltage of the second floating gate field effect transistor after programming the floating gate.

40. A computer program product on a computer readable medium for use in a data processing system for using an horological device, the computer program product comprising:

instructions for receiving a programming request to initialize the horological device; and

instructions for programming a first floating gate field effect transistor, wherein the first floating gate field effect transistor comprises a floating gate and an insulating region of insulating material adjacent to the floating gate, wherein a stored electrostatic charge discharges through a second floating gate field effect transistor, wherein a portion of the floating gate is common to the first floating gate field effect transistor and the second floating gate field effect transistor, wherein a discharge rate of a discharge process that discharges an electrostatic charge stored within the programmed floating gate is inversely related to a thickness of the insulating region, and wherein the thickness of the insulating region is selected such that a threshold voltage of the second floating gate field effect transistor has a predetermined decay rate after programming the floating gate.

41. An article of manufacture comprising:

an analog time cell; and

circuitry for allowing a state of the analog time cell to be modified or read.

42. The article of manufacture of claim 41 wherein the analog time cell transitions from a non-time-measuring state to a time-measuring state upon receiving an electrostatic charge.

43. The article of manufacture of claim 41 wherein the article of manufacture is a smart card.

44. The article of manufacture of claim 41 further comprising:

coupling means for coupling the article of manufacture to a reading device or programming device.

45. The article of manufacture of claim 41 further comprising:

time determining means for determining an elapsed time period since the analog time cell was programmed,